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Face Recognition System Based on LBPH Algorithm

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Abstract: ***In this modern time, identifying a person using a face is a standard biometric approach to distinguishing an individual from others. So techniques are required to identify a face must be quick and sufficiently enough to work in real time. But there are many difficulties within the execution of face identification in low lighting condition. In this paper, we have proposed a system that is using Local Binary Patterns Histogram algorithm for identifying a face. It can recognize both front and side faces and upgrade the value of poor enlightened picture and also expands the recognition rate in real time.***

Index Terms: ***Face recognition, LBPH, Histograms, Identification Process***

I. INTRODUCTION

Automatic face identification is an essential theme of computer vision and pattern recognition analysis. It will distinguish the personalities and different data as indicated by the optical highlights of face picture, having an exceptionally wide possibility for advancement. It is typically utilized in validation, criminal examination, police investigation, automaton intelligence, and healthful science, etc.

There are various techniques utilized in the face recognition system. Each distinctive features underneath varied conditions like illumination, expression and posture amendment. Among them, for our motivation that is confront discovery in the video stream, we tend to focus on three noteworthy methods and that we looked their execution underneath modified improvement condition to find an honest coordinating and low process expenses.

As the time passed, almost several researchers have developed a range of face detection and recognition algorithms, as well as Deep Convolution Network algorithm[1],Histograms of Oriented Gradients (HOG) algorithm[2],Sparse Coding(SC) algorithm[3],Gabor feature algorithm[4], Local Binary Pattern (LBP) algorithm[5], Linear Discriminate Analysis (LDA) algorithm[6], however additionally within the unceasing development. There are three different face identification techniques in the OpenCV library:, Fisherfaces[7], Eigenfaces[8] and Local Binary Pattern Histogram (LBPH)[9].

The contributions of this work tend to develop a real-time face recognition system that will acknowledge face in poor illumination condition and fetch information about that image from database

The paper has been divided into 7 sections. The first section introduces the readers to the essential of face recognition technique and our contribution. The second section offers existing work in details. Third section briefs regarding the face recognition algorithm. Forth section offers the methodology of the planned system. Fifth section deals with the experimental setup. The sixth section is regarding result and discussion and the last is the conclusion

II. RELATED WORK

Ojala et al. [10] initially used Local Binary Pattern (LBP). LBP refers unremarkably to displacement pixels with an 8-bit dual code from the neighborhood of the pixels. For a 3 square, the center component estimate is ablated from that of each of its eight neighboring pixels and is relegated to a bit based on the indication of the subtraction result 1 or 0. The created bits are then connected for all neighboring pixels and encoded into double strings. The dual strings inferred are referred to as Local Binary Patterns or LBP codes. The decimal estimate of the center component's LBP code (xc, yc). The LBP administrator LBP (P, R) produces 2p different yield values, about 2p distinctive two-fold examples formed by the P pixels within the varying R space. It has been shown that there is a lot of information in particular examples than others. It is conceivable to simply use a set of 2p double examples to portray the surface of the photographs. These examples were named by Ojala et al. as uniform examples.

All face images are viewed as the formation of small patterns that the LBP operator could recognize successfully. For face identification, Ahonen et al. [11] presented an LBP primarily based facial illustration. They have bifurcated facial images into M minor non-covering areas R(0), R(1), ..., R(M) to compare the facial structure. The LBP histograms extracted from each sub-region are then combined into a single, spatially enhanced histogram feature.. In [12] as suggested by Ahonen et al, the texture classification LBP approach describes the occurrence of LBP codes in an image being collected into a histogram. The classification is then carried out by calculating the similarities between straight-forward histograms. However, a loss of spatial data results in considering the same methodology for illustration of the facial image.

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An approach to achieving this goal is to use the LBP texture descriptors to create abundant local facial descriptions and combine them into a global description.

These local characteristics are primarily based on ways in which there are many robust causal or illumination variations compared to traditional ways. The essential methodology for LBP is based primarily on the facial description proposed by Ahonen et al. dividing the facial image into local areas and extracting the LBP texture descriptors separately from each area. Then the descriptors are joined together to describe the face globally. Effectively, this histogram features a face description on three completely different location levels: The LBP histogram labels contain data on unit pixel-level patterns, labels are added over a small region to integrate data at a regional level, and local histograms are also joined together to provide a global facial description. In [13], a face identification method with a high rate of detecting a face has been marked into 3 stages. Initially, a new picture is used for illustrating their properties, namely, “Integral Image”. Then, an easy AdaBoost classifier is utilized to choose a tiny variety of crucial visual highlights from a really massive set of effective properties. In the end, it is important to collaborate with the classifiers during a cascade to extract the background regions of the picture.

III. LOCAL BINARY PATTERN HISTOGRAM

Local Binary Patterns (LBP) is a perceptible descriptor style used in the classification of computer vision. LBP is the specific case of the 1990 proposed Texture Spectrum model. In 1994, LBP was represented for the first time. Since then, it has been found as a solid element for classifying texture. More specifically, once LBP is combined with the descriptor histogram of oriented gradients (HOG). It obviously improves the execution of identification on some datasets. Figure 1 illustrates the LBPH algorithm flowchart diagram.

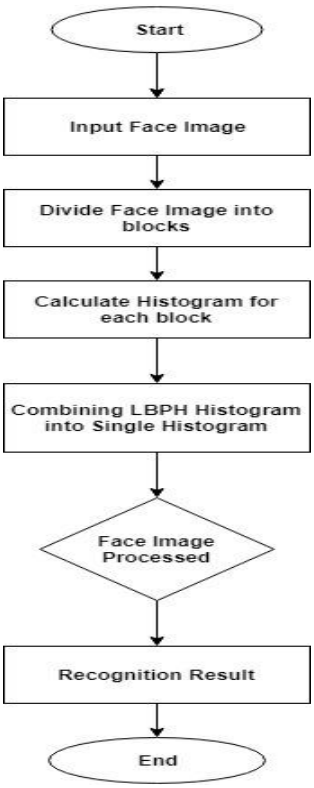

Figure 1: LBPH algorithm flowchart

The image is divided into cells (4 x 4 pixels) for the encoding of features. It is contrasted by using a clockwise or counter-clockwise bearing of surrounding pixel values.

The value of each neighbor's intensity is compared to the central pixel. The location is assigned a 1 or a 0 depending on the difference whether it is higher or lower than 0. The result gives a single cell an 8-bit value.

Figure 2 shows the matrix calculation comparing the value of the middle element of the matrix with the neighboring elements.

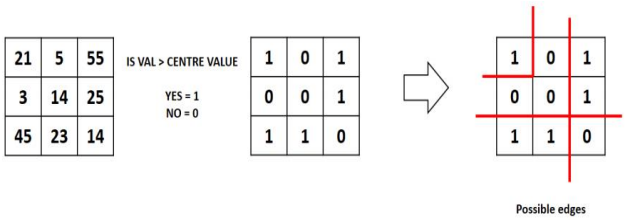

Figure 2: LBPH creating an 8-bit number

If the illumination condition of the image is changed, the final result is equivalent to the previous result. Histograms are used in larger cells as well as the frequency of values that make system robust. Edges can be identified as the quality changes by dissecting the results in the cell. It is possible to obtain feature vectors by calculating the values of all cells and connecting the histograms. Pictures can be grouped by ID-connected handling methods. Input pictures are classified using the same procedure and the data set is contrasted and separation is obtained. It is very well recognized by setting a limit value whether it is a known or obscure face. Figure 3 represents the values of the matrix when the light intensity is wavering.

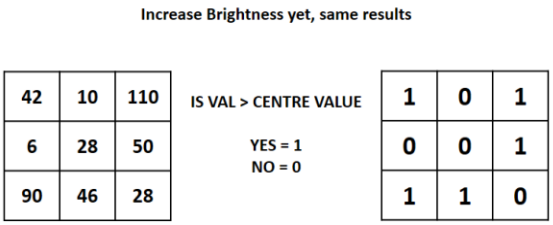

Figure 3: If the brightness changes, the results will be the same.

IV. METHODOLOGY

The proposed face recognition approach has four main steps: module for image acquisition, module for extraction of features, module for training classifier database, and module for classification. Initially, the face datasets are collected by the image acquisition module. Then, a series of salient features are extracted by applying feature extraction module. These facial features are used to analyze face landmarks which represent human identity information. In the next process, the classifier is trained for recognizing the face. In the last module, the system recognize face image and fetch information about the person from the SQLite database. The system flow chart is shown in Figure. 4

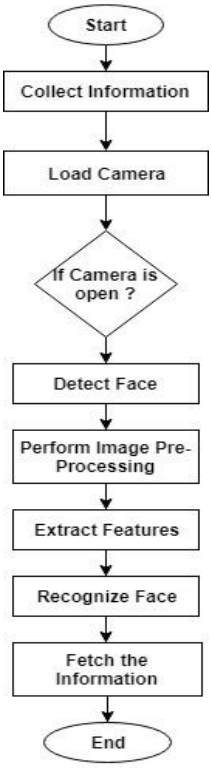

Figure 4: Face recognition system workflow

A. *Face Detection*

For face detection, OpenCV is used that introduces a Haar cascade classifier [15],[16]. The classifier of the Haar cascade uses the AdaBoost algorithm to locate numerous image facial features. Initially, it takes an input image using the camera and converts that color image into a grayscale image. After this, it loads Haar cascade classifier for determining whether the image contains any faces in the frame or not. When any face is detected, other facial features are checked and a square frame is drawn on the face. Otherwise, it starts reading other pictures. Figure 5 shows the flow chart of the detection process.

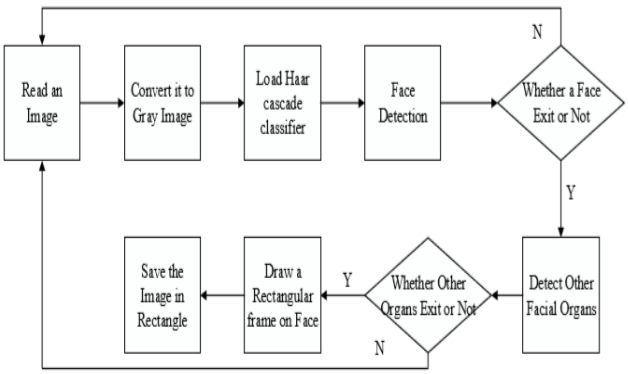

Figure 5: Face detection flow chart.

B. *Feature Extraction*

For extracting the facial features from image, the LBP operation is used that compares the intensity value of every component with the 8 nearest neighbour pixels values [17]. If the value of the neighboring pixel is greater than the value of the centered pixel, it will assign 1 to its neighboring pixel, otherwise it will assign 0. For each pixel, this task provides an 8-bit string. A decimal value of an 8-bit pixel string determines the LBP value. Fig. 6 shows this operation.

$$s(x) = \begin{cases} 1, & x \geq 0 \\ 0, & x < 0 \end{cases} \quad (1)$$

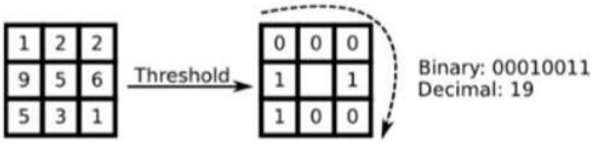

Figure.6 Extraction of LBP feature from the image

The input image is divided into many small sub-images after the application of the LBP operation and the histograms of the LBP value of each sub-images are extracted. Then all histograms are linked to make an image-representing feature vector and used to train a facial recognition classifier.

C. *Dataset*

We designed our own dataset, with 500 individual photos. Throughout the image acquisition process, face images are cropped and converted into gray images, then these images are saved in the same folder to make face databases for extraction tasks. After this, the standardization technique is applied to all images to reduce noise and set the correct image scaling position to quickly obtain the result of recognition. Dataset images are shown in Figure 7

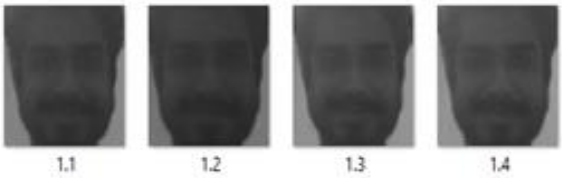

Figure 7. Dataset images

D. *Face Recognition*

For the face recognition process, Local Binary Pattern Histogram algorithm is applied. The LBP operator uses local binary patterns to reduce the local spatial distribution of a face image [18]. The LBP operator is a collection of binary pixel value ratios in the center at regular pixel intervals and is around 8 pixels. It is shown in the below equation.

$$LBP(x_c, y_c) = \sum_{n=0}^{7} S(i_n - i_c)2^n$$

Where i_c represents the index value of the middle pixel and (x_c, y_c) shows 8 close surrounding pixels data.

V. EXPERIMENTAL SETUP

To develop this system python programming language is used. OpenCV (3.0) library and other tools PyCharm and SQLite3 are used in this system. PyCharm is an integrated development Environment (IDE) employed for creating computer programs, specifically for the Python language.

SQLite is an RDBMS contained in a C programming library. As compared to other database management systems, it is not a client-server database system. It is embedded in the end program.

The whole project is divided into three parts facial detection, training face images and last the recognition of the faces. These all 3 operations are performed in PyCharm and information regarding a person like a name, age, gender is kept in the SQLite database.

VI. RESULTS AND DISCUSSION

To develop a face recognition system, first we have to prepare the face dataset for training. To develop face dataset, we used Face detection method that detects the face in real time camera and captured face images. That captured images are saved into dataset folder for feature extraction and training processes.

In the initial phase, system asks information about the person like name, age, gender and then the camera will open that captures 500 images of a person on different face position and expression. The information about person is saved into SQLite database and captured images are saved into dataset folder with same unique id.

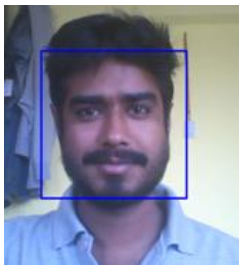

Figure 8. Face detection

In the next process, the system extracts the LBP texture features from every input dataset image and train them with the Haar Cascade classifier.

TABLE I. TRAINING IMAGES STATISTIC

Total Images	Trained Images	Training Time
500	500	10 sec

Finally, the system is performed face recognition process. First it detects all faces in the image, then it extracts facial feature from the input test face image. After this input feature vector is compared with the trained image dataset model using Haar Cascade Classifier. If the input test feature vector is matched with the trained model, it recognizes the face and fetches the information about that image from the SQLite database. The system can detect multiple faces in the image if any new face image comes into the camera frame system recognize the face on base on facial features

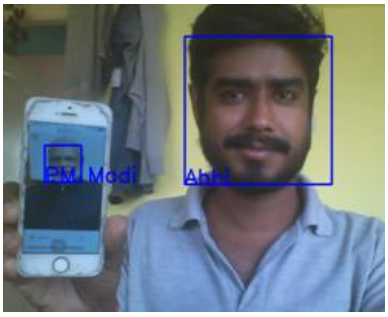

Figure 9. Recognizing face images.

VII. CONCLUSION

In the proposed face recognition system, we used Local Binary Patterns histogram algorithm for recognizing faces. The whole procedure is divided into three major components, i.e. detection of faces, facial feature extraction, and classification of the image. The Face detection process describes the face of a person in input image. In feature extraction, facial landmarks are extracted and to make an LBPH histogram that gives the completely unique result and then in recognition process the histogram of the input image is compared with database histogram using the classifier. The result shows that the system can recognize a known and unknown person. The problem in this proposed method is that, if the rate of change in the frame is very high and occlusion occurs, then the system will not robustly recognize faces. This problem can be considered as future work. This proposed system will assist security agencies in identifying criminals, for attendance purpose, to search any individual in a surveillance camera.

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